

# CS585 Project Description and Criteria

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## Project Purpose and Description

For the class project, you should identify an image or video based idea that you are interested in, articulate a specific task associated with that idea, identify data that you will use to develop your idea, identify the prior knowledge you have about the data and the task, design a technical approach for solving the task, then evaluate your results. You have broad latitude to choose your data, your problem, and to design your technical approach.

The purpose of the class project is to give you an opportunity to

- think critically about how to accomplish a task using image or video data
- practice a scientific approach to solving visual problems
- practice your written and oral communication skills

To find some inspiration, you can look around in your environment to see examples of computer vision at work. Some examples include automatic tagging on Facebook, automated check-reading at ATM's, and automatically displaying the line of scrimmage and other markers in televised (American) football games. Thinking about science fiction in movies and television can also be inspiring – how would you design a real-life gesture-based interface?

You can also thumb through the App store for your preferred mobile platform, where you will find apps for creating image mosaics, reading bar codes, identifying objects in images so that you can purchase them, and identifying plants in images. How would you go about implementing some of these ideas for your own app? What features are missing from these apps? (OpenCV has been ported to iOS and Android.) Common features on many cameras these days also use aspects of computer vision, such as automatic focusing, video stabilization, and high dynamic range images.

Friends who have visual tasks that they need to do for class work or research can also be helpful. I like Biologists for this purpose; they always have a lot of data that needs to be analyzed. What data do they have to analyze that is tedious, time-consuming, and error-prone that you might be able to help automate? Finally, you can do some searching on the internet for topics related to the applications laid out in the syllabus (object detection, object recognition, object tracking, surveillance, study of animal behavior, robot navigation, video stabilization, and image mosaics).

If there is a task you are interested in, but you are afraid it is "too hard," you should spend a little time looking through OpenCV or other libraries to see what is already implemented and available. You don't have to do novel technical work – pulling together algorithms that are already implemented into a new system can be fun! You are free to constrain your problem in order to make a solution feasible. You should be sure that you can obtain data related to the task that

you are interested in, either through publicly available data sets, by collecting data yourself, or by obtaining it from a friend. Visual Studio 2012 with OpenCV 2.4.7 is provided on the lab computers. We also have four Microsoft Kinect's and several webcams available for the class to use.

Here are some ideas:

- Identifying and tracking fish in video
- Identifying wing damage in photographs to help study white nose syndrome in bats
- A gesture-based interface to do something fun with images
- Using a Kinect (a sensor made by Microsoft for use with the XBox; it contains a camera and a depth sensor.) to recognize body pose
- Tracking people in video
- Surveillance (many public data sets)
- Automatically cropping images to remove excess background
- Content-based image retrieval (automatically identify images that "look like" other images)
- Content-based geo-tagging (identify famous landmarks)
- Object recognition system
- Activity recognition system
- Artistic image editing with computer vision algorithms
- Recognizing and counting cells in images (there are many public databases)
- License plate recognition

## 1 Phase 1: Proposal

### Due Feb 11

For the first phase, each person will write a **proposal about three image and video-related tasks that you are interested in attempting to do**. These proposals are non-binding; you can change your mind or do something entirely different for the final deliverable.

The purpose of the proposal is to get you started thinking about what kinds of problems you are interested in, how you might approach them, and what your evaluation criteria will be. You should identify some data that exemplifies the task, and think a little bit about your wish list for the quantitative things you would like to be able to compute about the content of the images in order to accomplish your task. You should also identify potential problems that you may need to overcome in order to compute the things you want to compute and accomplish your task.

Each person will share their proposal with another student in the class, who will provide some feedback. I will also provide feedback about your ideas. The proposal should be approximately three pages (one page per task), including pictures.

The grading criteria will be

- You have identified and described three different ideas / tasks
- You have identified what it means to successfully accomplish each task
- You have identified a potential source of data for each of the tasks
- You have identified at least two sub-problems that you will need to address in order to be able to accomplish each task
- You have identified at least two potential sources of difficulty for each task (sources of difficulty may recur across tasks)
- You provide feedback on the other student's proposal

## 2 Phase 2: Progress Report and Peer Review

### Due March 25

For the second phase, you will form groups of 1 – 4 people. You may keep the groups I previously assigned, or form new groups. Each group will design a task to work on, drawing from the ideas of the group members. After choosing a source of data, each group will develop a technical approach to attempt to solve the problem.

The deliverable will be a **progress report of approximately five pages**, including pictures, where you detail the task you have chosen, what it means to successfully complete the task, the data you are working with, your prior knowledge and assumptions about the data, the sub-tasks that you have identified, the technical approaches you have used to attempt to address each sub-task, and what has worked or not and why.

If you are having trouble getting results that you consider good, you should suggest how you may revise the task, revisit your assumptions, constrain your input, or try additional technical approaches. Each group will share their progress report with three of your classmates, who will provide feedback. I will also provide feedback.

The grading criteria will be

- You have identified a specific task that you are trying to perform (your problem statement)
- You have identified what it means to successfully accomplish the task
- You have identified a source of data that is a good match for the task
- You have identified prior knowledge and assumptions about the data
- You have divided the task into sub-tasks that are specific, the results are measurable, and a solution seems feasible (you do not need to have completed all of these tasks by the date of the progress report)
- You have identified potential technical approaches to apply to each sub-task that are well matched to the assumptions you have made
- If your preliminary or intermediate results are not good, you have identified why this is, and proposed how you will revise your problem statement or technical approach in order to achieve success by the final date
- If your preliminary or intermediate results are good, you have identified the next steps you will take to extend the work for the final date
- You provide feedback to your classmates

## 3 Phase 3: Final Report and Presentation

### Due April 29

The final projects will be due the last week of the semester. They should have the same elements as the proposals, but also include results.

The final deliverables will be:

- an in-class presentation of approximately 15 minutes
- a written report of approximately five pages (including pictures)
- your code

The grading criteria will be

- you clearly articulate a problem statement (which may have changed since the progress report)
- you describe of your measures for success (which may have changed since the progress report)
- you describe the data that you are using (which may have changed since the progress report)
- you describe your prior knowledge and assumptions that you are using in your technical approach
- you describe the key aspects of your technical approach
- you describe your results
- you discuss why your approach was successful or not
- you propose ways that the work could be taken forward